

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

5 Appellant(s): Dennis R. Morgan
Docket No: Morgan 13
Serial No.: 10/775,911
Filing Date: February 10, 2004
Group: 2613
10 Examiner: Nathan M. Curs

Title: Method and Apparatus for Two-Port Allpass Compensation of
Polarization Mode Dispersion

15

REPLY BRIEF

20 Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

25 Sir:

Appellant hereby replies to the Examiner's Answer, mailed July 20, 2010
(referred to hereinafter as "the Examiner's Answer"), in an Appeal of the final rejection
of claims 1-5, 7-11 and 13-22 in the above-identified patent application.

30

REAL PARTY IN INTEREST

A statement identifying the real party in interest is contained in
Appellant's Appeal Brief.

35

RELATED APPEALS AND INTERFERENCES

A statement identifying related appeals is contained in Appellant's Appeal
Brief.

STATUS OF CLAIMS

A statement identifying the status of the claims is contained in Appellant's Appeal Brief.

5

STATUS OF AMENDMENTS

A statement identifying the status of the amendments is contained in Appellant's Appeal Brief.

SUMMARY OF CLAIMED SUBJECT MATTER

10

A Summary of the Invention is contained in Appellant's Appeal Brief.

STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A statement identifying the grounds of rejection to be reviewed on appeal is contained in Appellant's Appeal Brief.

15

CLAIMS APPEALED

A copy of the appealed claims is contained in an Appendix of Appellant's Appeal Brief.

20

ARGUMENT

Point 1

In the Examiner's Answer (pages 12-13), the Examiner asserts that the first (cited) reason amounts to arguing that a person of ordinary skill would not recognize how to adapt two-port all-pass filters using the LMS algorithm because of a failure of the prior art to anticipate such an adaptation and that this argument is not persuasive because anticipation is not required for a proper obviousness rejection.

25

The failure of the prior art to not anticipate the claimed invention is evidence of non-obviousness. In any case, Appellants maintain that the cited *obviousness* rejection is *not* proper because a person of ordinary skill would *not* recognize how to adapt two-port all-pass filters using the LMS algorithm.

30

Point 2

In the Examiner's Answer (pages 12-13), the Examiner asserts that the second (cited) reason amounts to arguing that a person of ordinary skill would not recognize how to adapt two-port all-pass filters using the LMS algorithm because LMS algorithms are for FIR and/or single channel filters and do not apply to two-port all-pass filters. The Examiner asserts that the paper's derivation of equations for making the LMS and Newton algorithms applicable to two-port all-pass filters is not evidence that the LMS and Newton algorithms are everywhere else inapplicable to two-port all-pass filters.

Appellants maintain, however, that the cited algorithm provides evidence of the complexity of adapting two-port all-pass filters using the LMS algorithm and provides evidence that the cited adaptation would *not* be obvious to a person of ordinary skill in the art.

Point 3

In the Examiner's Answer (pages 13-14), the Examiner asserts that the primary reference, Madsen, discloses two-port all-pass filters and that the use of such filters is not at issue.

Contrary to the Examiner's assertion, the use of two-port all-pass filters (using the LMS algorithm) is at issue. As noted in the cited argument and described in the Appeal Brief, persons of ordinary skill in the art are inclined to use FIR filters and, due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. Even with Madsen's disclosure of two-port all-pass filters, a person of ordinary skill in the art would *not* be motivated to use the LMS algorithm as none of the cited references address the complexities and techniques involved in adapting two-port all-pass filters using the LMS algorithm. A person of ordinary skill in the art would *not* have a reasonable anticipation of success in adapting two-port all-pass filters using the LMS algorithm.

Point 4

In the Examiner's Answer (pages 13-14), the Examiner asserts that appellants' argument that the combination cited by the Examiner would not work is not persuasive.

5 Appellant notes that "LMS" and "Newton" are general methods for deriving algorithms. The details of the derivation for adapting two-port all-pass filters are documented in the reference cited in the Appendix. The derivation is *not* trivial, and cannot be found in any of the references cited by the Examiner.

As noted in the Appeal Brief, while the cited paper provides the details of
10 the derivation, it does *not* disclose or suggest the *claimed method and device for compensating for polarization mode dispersion in an optical fiber communication system and for compensating for polarization mode dispersion in an optical fiber communication system*.

Point 5

15 In the Response to Arguments section of the final Office Action, the Examiner asserts that McFarlane teaches that filtering is based on the need to compensate for three types of dispersion, including polarization dispersion, which is PMD (col. 1, lines 43-46). Appellant notes that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion
20 that the invention of McFarlane fulfills this need. Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is *no* disclosure or suggestion to *compensate for polarization mode dispersion*.

In the Examiner's Answer (pages 14-15), the Examiner further asserts that the cited argument is not persuasive because MacFarlane's signal processing filter is
25 presented as a solution in the context of the issues presented in the background section, including the need for compensation of irregularities that include PMD. The Examiner further asserts that Madsen already provides the PMD compensation teaching, and MacFarlane is nevertheless disclosing a least mean squares algorithm as an alternative to a least squares algorithm for minimizations.

30 Appellant notes that MacFarlane does *not* suggest that every problem disclosed in the background section is solved in the MacFarlane disclosure. As noted

above, there is *no* disclosure or suggestion in MacFarlane to *compensate for polarization mode dispersion*, and *no* disclosure or suggestion that a least mean squares algorithm is an alternative to a least squares algorithm for minimizations in the context of the Madsen invention.

5 Point 6

In the Examiner's Answer (page 15), the Examiner asserts that Eyal's express use of the term "coefficient" is not a universally controlling use of the term.

Appellants maintain that, regardless of whether Eyal's express use of the term "coefficient" is universally controlling, it is controlling in any interpretation of Eyal's disclosure, and in particular to the text cited by the Examiner.

Point 7

In the Appeal Brief, Appellant has argued that MacFarlane et al. does **not** teach that the filter coefficients can be adjusted using a variety of minimization algorithms including an LMS algorithm (citing col. 19, lines 16-22). *While the LMS algorithm is discussed at col. 19, lines 16-22, it is **not** in connection with the adjustment of filter coefficients.* Rather, the discussion at col. 19, lines 16-22 is directed to adjusting "the gains on an on-going basis (of a network traffic router) to minimize error correction coding related error rates" (lines 11-13). It is further noted that as "the gains are adjusted, the control signal values in the look-up tables are also preferably updated as well." *Id.* at lines 14-16. Appellant can find **no** disclosure or suggestion in MacFarlane et al. to adjust the ***coefficients of a filter*** (especially a two-port all-pass filter) using the LMS algorithm (and especially in the context of reducing polarization mode dispersion).

In the Examiner's Answer (pages 15-16), the Examiner asserts that the LMS disclosure is tied to adaptive signal processing algorithms for adjusting the filters to minimize errors and that MacFarlane teaches that a least mean squares algorithm and a least squares algorithm are alternatives for minimizations.

While the LMS disclosure may be *tied* to adaptive signal processing algorithms, *the discussion of the LMS algorithm at col. 19, lines 16-22 is **not** in connection with the adjustment of filter coefficients.* Also, as noted above, there is *no* disclosure or suggestion in MacFarlane to *compensate for polarization mode dispersion*,

and *no* disclosure or suggestion that a least mean squares algorithm is an alternative to a least squares algorithm for minimizations in the context of the Madsen invention.

Point 8

In the Appeal Brief, Appellant has argued that the noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

In the Examiner's Answer (pages 16-17), the Examiner asserts that, whatever complexity may be involved in implementing a two-port all-pass filter, Madsen has already taken care of this by using one. The Examiner asserts that the minimization function already disclosed by Madsen makes for quick and accurate dispersion compensation and that the LMS minimization algorithm is an alternative to the one already disclosed and so it could be used for the same reasons as the original.

As noted in the cited argument and described in the Appeal Brief, persons of ordinary skill in the art are inclined to use FIR filters and, due to the complexity of an implementation with two-port all-pass filters, would *not* be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. The Examiner has provided no support for the assertion that Madsen has "taken care of" the complexities of adapting two-port all-pass filters using the LMS algorithm.

Point 9

In the Appeal Brief, Appellant noted that the Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *Newton algorithm*. The Examiner asserts, however, that various optimization algorithms are known and that Eyal et al. teach a system including optical filters for compensating for polarization mode dispersion having adjusted coefficients (page 1088) and that the filter coefficients are adjusted using a Newton algorithm (citing page 1089, end of first par. of right column).

Eyal et al., however, do not disclose or suggest that the polarization mode dispersion is reduced “using a cascade of two-port all-pass filters,” and the Examiner has not alleged that Eyal et al. discusses all-pass filters.

5 In the Examiner’s Answer (page 17), the Examiner asserts that Madsen already discloses reducing PMD using a cascade of two-port all-pass filters and that there is no requirement for Eyal to provide a duplicate teaching.

Regardless of whether Madsen already discloses reducing PMD using a cascade of two-port all-pass filters, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph. Furthermore, neither Madsen nor Eyal teach how to adapt two-port all-pass filters using the LMS or Newton algorithm.

10
15

Appeal Brief Arguments

Formal Objections

Claim 18 was objected to because the phrase “adjusting step” should be “adjustment” for consistency.

20

Appellant maintains that the cited phrase “adjusting step” is consistent with the term “adjusted” and explicitly addresses the previous section 101 rejection by requiring that a *step* is performed by a device.

Appellant respectfully requests that the formal objections be withdrawn,

Section 103 Rejections

25

Independent claims 1 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of MacFarlane et al. With regard to claim 1, for example, the Examiner asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of

30

all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete par.).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *least mean square algorithm*. The Examiner asserts, however, that MacFarlane et al. teach a system related to Madsen including optical filters for compensating for polarization mode dispersion having adjusted coefficients (col. 1, lines 28-53, col. 2, lines 51-65 and col. 5, lines 23-42). The Examiner further asserts that MacFarlane et al. teach that the filter coefficients can be adjusted using a variety of minimization algorithms including a least squares algorithm or an LMS algorithm (col. 19, lines 16-22).

Appellant notes that independent claims 1 and 13 require adjusting coefficients of said two-port all-pass filters using a *least mean square algorithm*. Support for this limitation can be found, for example, in FIGS. 5 and 6 and the associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Appellant acknowledges that the use of the LMS algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Appellant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters. It is *not* known to adapt two-port all-pass filters using the LMS algorithm. Furthermore, the adaptation equations for FIR filters and/or single-channel all-pass filters do not apply to the adaptation of two-port all-pass filters. Thus, a person of ordinary skill in the art would *not* recognize how to adapt two-port all-pass filters using the LMS algorithm.

In the Response to Arguments section of the final Office Action, the Examiner asserts that Appellant has not provided any reasoning or evidence in support of the statement that the adaptation equations for FIR filters and/or single-channel all-pass filters do not apply to the adaptation of two-port all-pass filters.

Appellant has previously submitted a paper entitled “Adaptive Algorithms for Two-Port Allpass Compensation of Polarization Mode Dispersion” dated September 23, 2002 and authored by Appellant. As described in the abstract, the cited paper

describes the derivation of a Newton-type algorithm, for example, in the context of a two-port structure consisting of multiple cascades of allpass filters and directional couplers. Since the adaptation equations for FIR filters and/or *single-channel* all-pass filters are not applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton
5 algorithm, section III describes a derivation of the equations that are applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton algorithm. Appellant maintains that the derivation of the cited equations would not be obvious to a person of ordinary skill in the art.

In the Advisory Action, the Examiner asserts that the “do not apply”
10 assertion only implies some kind of rule-of-thumb or common practice known to Applicant for LMS algorithms, but it is not evidence that the substitution cannot be made.

Contrary to the Examiner’s assertion, Appellant maintains that the statement that “the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*” is not merely “some
15 kind of rule-of-thumb or common practice”; rather, it is an explicit statement that the adaptation equations for FIR filters and/or *single-channel* all-pass filters are *not* useful for adapting *two-port all-pass filters*, as evidenced by the cited paper.

In further support of Appellant’s position that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the
20 adaptation of *two-port all-pass filters*, Appellant notes that, for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and, due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition,
25 since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*, the combination suggested by the Examiner *would not work*.

In the Response to Arguments section of the final Office Action, the Examiner asserts that the above argument is not persuasive because two-pass all-port
30 filters are expressly disclosed by Madsen. Appellant maintains, however, that in light of Madsen and MacFarlane, a person of ordinary skill in the art would select an FIR filter

due to the complexity of utilizing two-port all-pass filters and the fact that the combination suggested by the Examiner *would not work*.

Similarly, Appellant notes that independent claims 7 and 18 require adjusting coefficients of said two-port all-pass filters using a Newton algorithm. Support
5 for this limitation can be found, for example, in FIGS. 5 and 6 and the associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Appellant acknowledges that the use of the Newton algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Appellant strongly asserts, however, that it would
10 *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is *not* known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters and/or single-channel all-pass filters do not apply to the adaptation of two-port all-pass filters. Thus, a person of ordinary skill in the art would *not* recognize how to
15 adapt two-port all-pass filters using the Newton algorithm.

In further support of Appellant's position that it would *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters, Appellant notes that for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement.
20 Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with two-port all-pass filters, would *not* be motivated to utilize a two-port all-pass filter in combination with a Newton algorithm in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of two-port all-pass
25 filters, the combination suggested by the Examiner *would not work*. Thus, a person of ordinary skill in the art would be motivated to utilize a FIR filter.

In the Response to Arguments section of the final Office Action, the Examiner asserts that McFarlane teaches that filtering is based on the need to compensate for three types of dispersion, including polarization dispersion, which is PMD (col. 1,
30 lines 43-46). Appellant notes that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion

that the invention of McFarlane fulfills this need. Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is *no* disclosure or suggestion to *compensate for polarization mode dispersion*.

5 The Examiner also reiterates that Eyal teaches adjusting coefficients using a Newton algorithm since Eyal teaches "using a Newton algorithm to optimize variables in equations for producing optimized filter coefficients."

Contrary to the Examiner's assertion, Eyal does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

15 In the Response to Arguments section of the final Office Action, the Examiner asserts that the optimization variables of Eyal are effectively filter coefficients for the compensating filter, regardless of Eyal's use of the term "coefficient" for other designations. Appellant finds no rationale in apparently disregarding Eyal's teachings regarding the term "coefficient."

20 Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

Also, contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is no disclosure or suggestion to *compensate for polarization mode dispersion*.

30 Thus, MacFarlane et al. does not disclose or suggest the step of "reducing said polarization mode dispersion." In addition, MacFarlane et al. does not disclose or

suggest that the polarization mode dispersion is reduced “using a cascade of two-port all-pass filters,” and the Examiner has not alleged that MacFarlane et al. discusses all-pass filters.

5 In addition, again contrary to the Examiner’s assertion, MacFarlane et al. does **not** teach that the filter coefficients can be adjusted using a variety of minimization algorithms including an LMS algorithm (citing col. 19, lines 16-22). *While the LMS algorithm is discussed at col. 19, lines 16-22, it is **not** in connection with the adjustment of filter coefficients.* Rather, the discussion at col. 19, lines 16-22 is directed to adjusting “the gains on an on-going basis (of a network traffic router) to minimize error correction coding related error rates” (lines 11-13). It is further noted that as “the gains are adjusted, the control signal values in the look-up tables are also preferably updated as well.” *Id.* at lines 14-16. Appellant can find **no** disclosure or suggestion in MacFarlane et al. to adjust the ***coefficients of a filter*** (especially a two-port all-pass filter) using the LMS algorithm (and especially in the context of reducing polarization mode dispersion).

15 In the Response to Arguments section of the final Office Action, the Examiner asserts that the LMS disclosure is tied to adaptive signal processing algorithms for adjusting the filters to minimize errors, which includes those caused by PMD in light of col. 1, lines 43-46. Appellant reiterates that the text cited by the Examiner describes a “need” recited in the Background section of McFarlane. There is *no* disclosure or suggestion that the disclosed LMS algorithm is in connection with the adjustment of filter coefficients.

25 Appellant has previously acknowledged that the use of the LMS algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the LMS algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt two-port all-pass filters using the LMS algorithm.

30 An Examiner must establish “an apparent reason to combine ... known elements.” *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385

(2007). Here, the Examiner states that it would have been obvious to implement the LMS adaptation of MacFarlane et al. in the system of Madsen as an “engineering design choice” of another way to provide the minimization function. As discussed hereinafter, the use of the LMS algorithm in the manner suggested only by the present invention is
5 more than a mere design choice. Again, any discussion of adaptation using the LMS algorithm is not in the context of adjusting the *coefficients of a filter* (especially a two-port all-pass filter in the context of reducing polarization mode dispersion).

In the Response to Arguments section of the final Office Action, the Examiner asserts that Appellant does not provide reasoning or evidence against the use of
10 LMS over LS as a design choice. As noted above, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Moreover, a person of ordinary skill in the art would not recognize how to adapt *two-port all-pass filters* using the LMS algorithm. Thus, the use of the LMS algorithm in the manner suggested only by the present invention is not a mere design choice.

15 Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a least mean square algorithm*.

There is *no* suggestion in Madsen or in MacFarlane et al., alone or in
20 combination, to adjust coefficients of a cascade of two-port all-pass filters *using a least mean square algorithm*.

In further support of Appellant’s position that it would not have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters, Appellant notes that for most applications, an all-
25 pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port
30 all-pass filter, the combination suggested by the Examiner *would not work*.

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art *teaches away* from the present invention. The *KSR* Court discussed in some detail *United States v. Adams*, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (*KSR* Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

In the Response to Arguments section of the Office Action, the Examiner notes, in regard to Appellant's argument that "the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter," that the rejected claims do not recite particular equations.

Appellant notes that the cited argument was presented to illustrate that the Examiner's proposed combination of references was *not* valid because the combination suggested by the Examiner *would not work*. Appellant's argument is valid regardless of whether the equations are recited in the claims.

In the Advisory Action, the Examiner asserts that the document submitted in the IDS of March 5, 2010 establishes that the subject matter of the claims was "known by others" as of September 2002."

As described in the abstract, the cited paper describes the derivation of a *Newton-type algorithm*, for example, in the context of a two-port structure consisting of multiple cascades of allpass filters and directional couplers. The cited paper does *not* disclose or suggest, however, the *claimed method and device for compensating for polarization mode dispersion in an optical fiber communication system and for compensating for polarization mode dispersion in an optical fiber communication system*.

Claims 7 and 18

Independent claims 7 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of Eyal et al. With regards to claims 7 and 18, the Examiner again asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete paragraph).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *Newton algorithm*. The Examiner asserts, however, that various optimization algorithms are known and that Eyal et al. teach a system including optical filters for compensating for polarization mode dispersion having adjusted coefficients (page 1088) and that the filter coefficients are adjusted using a Newton algorithm (citing page 1089, end of first par. of right column).

Eyal et al., however, do not disclose or suggest that the polarization mode dispersion is reduced “using a cascade of two-port all-pass filters,” and the Examiner has not alleged that Eyal et al. discusses all-pass filters.

In addition, contrary to the Examiner’s assertion, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a

two-port all-pass filter. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

An Examiner must establish “an apparent reason to combine ... known elements.” *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner merely states that it would have been obvious to implement the Newton adaptation of Eyal et al. in the system of Madsen as an “engineering design choice” of another way to provide the minimization function. As discussed hereinafter, the use of the Newton algorithm in the manner suggested only by the present invention is more than a mere design choice.

Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a Newton algorithm*.

There is *no* suggestion in Madsen or in Eyal et al., alone or in combination, to adjust coefficients of a cascade of two-port all-pass filters *using a Newton algorithm*.

In further support of Appellant’s position that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters, Appellant notes that for most applications, an all-pass filter is not advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter, in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter, the combination suggested by the Examiner *would not work*.

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner’s contention that the combination is motivated by a desire to “quickly and accurately compensate (for) dispersion.” In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere “substitution” of one minimization algorithm for another.

This information known to those of ordinary skill in the art *teaches away* from the present invention. The *KSR* Court discussed in some detail *United States v. Adams*, 383 U.S. 39 (1966), stating in part that in that case, “[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious.” (*KSR* Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

Appellant respectfully requests the withdrawal of the rejection of independent claims 1, 7, 13 and 18.

The rejections of the cited claims under section 103 in view of *Madsen et al.*, *MacFarlane et al.*, Applicant’s Admitted Prior Art, and *Eyal et al.*, alone or in any combination, are therefore believed to be improper and should be withdrawn. The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims. The Examiner has already indicated that Claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

All of the pending claims, i.e., claims 1-22, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner or the Appeal Board has any further suggestions for expediting allowance of this application, the Examiner and the Appeal Board are invited to contact the undersigned at the telephone number indicated below.

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully submitted,

5



Date: September 20, 2010

10

Kevin M. Mason
Attorney for Appellants
Reg. No. 36,597
Ryan, Mason & Lewis, LLP
1300 Post Road, Suite 205
Fairfield, CT 06824
(203) 255-6560

APPENDIX

1. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:
- 5 reducing said polarization mode dispersion using a cascade of two-port all-pass filters; and
- adjusting coefficients of said two-port all-pass filters using a least mean square algorithm, wherein said adjusting step is performed by a device.
- 10 2. The method of claim 1, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
3. The method of claim 1, wherein said coefficient values are adjusted to
- 15 minimize a cost function.
4. The method of claim 1, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
- 20 5. The method of claim 4, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.
6. The method of claim 1, wherein said cascade of two-port all-pass filters comprises a first all-pass filter A having a vector a comprised of P coefficients and a
- 25 second all-pass filter B having a vector b comprised of Q coefficients and wherein said least mean square algorithm adjusts said coefficients as follows:

$$w(n+1) = w(n) - \mu \nabla(J),$$

where n indicates the current iteration number and w is a composite coefficient vector defined as:

30
$$w = \begin{bmatrix} a \\ b \end{bmatrix}, \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial a^T} & \frac{\partial J}{\partial b^T} \end{bmatrix}^T$$

is the $(P+Q) \times 1$ complex gradient of J with respect to \mathbf{w} and T indicates a transpose operation, and

$$\frac{\partial J}{\partial \mathbf{a}^T} \equiv \left[\frac{\partial J}{\partial a_1} \quad \frac{\partial J}{\partial a_2} \quad \cdots \quad \frac{\partial J}{\partial a_p} \right], \text{ and}$$
$$\frac{\partial J}{\partial \mathbf{b}^T} \equiv \left[\frac{\partial J}{\partial b_1} \quad \frac{\partial J}{\partial b_2} \quad \cdots \quad \frac{\partial J}{\partial b_q} \right].$$

5

7. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:

reducing said polarization mode dispersion using a cascade of two-port all-pass filters; and

10 adjusting coefficients of said two-port all-pass filters using a Newton algorithm, wherein said adjusting step is performed by a device.

8. The method of claim 7, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and
15 directional couplers.

9. The method of claim 7, wherein said coefficient values are adjusted to minimize a cost function.

20 10. The method of claim 7, further comprising the step of measuring said polarization mode dispersion in a received optical signal.

11. The method of claim 10, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

25

12. The method of claim 7, wherein said cascade of two-port all-pass filters comprises a first all-pass filter A having a vector \mathbf{a} comprised of P coefficients and a second all-pass filter B having a vector \mathbf{b} comprised of Q coefficients and wherein said Newton algorithm adjusts said coefficients as follows:

$$\mathbf{w}(n+1) = \mathbf{w}(n) - \mu \mathbf{H}^{-1} \nabla(J)$$

where n indicates the current iteration number and \mathbf{w} is a composite coefficient vector defined as:

$$\mathbf{w} = \begin{bmatrix} \mathbf{a} \\ \mathbf{b} \end{bmatrix}, \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial \mathbf{a}^T} & \frac{\partial J}{\partial \mathbf{b}^T} \end{bmatrix}^T$$

$$\frac{\partial J}{\partial \mathbf{a}^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \dots & \frac{\partial J}{\partial a_p} \end{bmatrix}, \text{ is the } (P+Q) \times 1 \text{ complex gradient of } J \text{ with respect to } \mathbf{w},$$

T indicates a transpose operation and, a Hessian matrix, \mathbf{H} , is defined as follows:

$$\mathbf{H} = \frac{\partial^2 J}{\partial \mathbf{w} \partial \mathbf{w}^T} = \begin{bmatrix} \frac{\partial^2 J}{\partial \mathbf{a} \partial \mathbf{a}^T} & \frac{\partial^2 J}{\partial \mathbf{a} \partial \mathbf{b}^T} \\ \frac{\partial^2 J}{\partial \mathbf{b} \partial \mathbf{a}^T} & \frac{\partial^2 J}{\partial \mathbf{b} \partial \mathbf{b}^T} \end{bmatrix} \text{ and}$$

$$\frac{\partial J}{\partial \mathbf{b}^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \dots & \frac{\partial J}{\partial b_Q} \end{bmatrix}.$$

13. A polarization mode dispersion compensator in an optical fiber communication system, comprising:

a cascade of two-port all-pass filters having coefficients that are adjusted using a least mean square algorithm, wherein said adjustment is performed by a device.

14. The polarization mode dispersion compensator of claim 13, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

15. The polarization mode dispersion compensator of claim 13, wherein said coefficient values are adjusted to minimize a cost function.

16. The polarization mode dispersion compensator of claim 13, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.

17. The polarization mode dispersion compensator of claim 16, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.
- 5 18. A polarization mode dispersion compensator in an optical fiber communication system, comprising:
a cascade of two-port all-pass filters having coefficients that are adjusted using a Newton algorithm, wherein said adjusting step is performed by a device.
- 10 19. The polarization mode dispersion compensator of claim 18, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
20. The polarization mode dispersion compensator of claim 18, wherein said
15 coefficient values are adjusted to minimize a cost function.
21. The polarization mode dispersion compensator of claim 18, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.
- 20 22. The polarization mode dispersion compensator of claim 21, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.

EVIDENCE APPENDIX

Dennis R. Morgan, "Adaptive Algorithms for Two-Port Allpass Compensation of Polarization Mode Dispersion", IEEE Trans. Signal Processing, September, 2002.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.